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PENETROMETER SOIL RESISTANCE, POD NUMBER AND YIELD OF PEANUTS AS INFLUENCED BY DROUGHT STRESS

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SUMMARY

Variations in penetrometer soil resistance (PSR) as a result of drought stress at different growth phases, and it's relationship to pod production and yield of peanut (*Arachis hypogaea* L. cv Robut 33-1) were evaluated under field conditions during post-rainy season. Pod number per plant decreased linearly with increase in PSR. Final yield, however, was not directly related to the mean seasonal PSR since PSR, *Per se*, does not reduce yield.

INTRODUCTION

In peanut (*Arachis hypogaea* L.), the peg must penetrate 2 to 7 cm of soil surface before pod development occurs and as such pegging is sensitive for soil water levels in the rooting zone (Smith, 1950 and Klepper, 1973). Root penetration also decreased with increased soil strength (Taylor *et al.*, 1966). According to Taylor and Ratliff (1969) a penetrometer resistance of 2 MPa was required to reduce peanut penetration rate by 50% and soil water potential between —0.02 and 1.25 MPa did not affect the elongation of peanut roots. It is not, however, known whether this relationship holds good in all growth phases of peanuts since some growth phases are known to be very sensitive to drought stress. Keeping this in view an experiment was conducted to examine variations in penetrometer soil resistance (PSR) and it's relationship to pod number and yield of peanuts when drought stress was imposed at different growth phases.

MATERIALS AND METHODS

The experiment was conducted at the International Crops Research Institute for

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the Semi-Arid Tropics (ICRISAT), Patancheru, India, on a medium deep Alfisol during 1982-83 Post-rainy season. The treatments comprise of drought stress imposed at 4 different phenological phases as main treatments as detailed below :

(1) emergence to flowering
(2) emergence to initiation of pegs
(3) flowering to last pod set, and
(4) continuous water application using line source every 7 days throughout the season.

The above treatments were imposed by using line source sprinkler irrigation (Hanks *et al.*, 1976). Based on the amount of water applied as a function of distance from the line source i.e., at 3, 9 and 15 m in treatments 1 to 4, three sub-treatments A, B and C respectively were identified in each treatment. The design adopted was split-plot with 4 replications. Total amount of water applied in different treatments is shown in Table I.

Table I. Amount of water applied in different treatments during post-rainy season

Treatment	Distance from the line source (m)	Net amount of water applied (mm)
1 A	3	665
B	9	657
C	15	623
2 A	3	630
B	9	589
C	15	522
3 A	3	603
B	9	553
C	15	477
4 A	3	739
B	9	409
C	15	27

Peanut (cv Robut 33-1) was sown on 29th October 1982 and emergence was completed by 5th November. A basal dressing of 100 kg/ha of diammonium phosphate (18 N : 20 P_2O_5) was applied. Necessary plant protection measures were taken to keep the plots free from weeds and pests.

Soil water measurements were made in each sub-treatment using a type I.H.II neutron moisture meter (Didcot Instrument Co. Ltd. Abingdon, England) at 7-10

day intervals from 30-120 cm depth at 15 cm interval while the soil moisture upto 30 cm soil depth was measured by the gravimetric method.

PSR was measured with a proving ring penetrometer (Soil Test Inc., Evanston, Illinois, USA) and using the calibration, a maximum penetration load in MPa was determined. Measurements were made at 0-7 cm soil depth from the surface at 5 locations in each plot twice a week from the growth phase of beginning pegging i.e., 44 days after emergence (DAE) upto pod development (107 DAE).

Pod measurements were part of the growth analysis carried out on a weekly basis throughout the season. Pod and kernel yields were obtained from a net area of 9 m^2 in each plot. Since the levels of water applied could not be randomised due to use of the line source sprinkler irrigation system, data were analysed for each drought stress treatment and for each sampling day separately in a randomised block design and standard errors were provided.

RESULTS AND DISCUSSION

A wide variation in PSR was observed between the 4 drought stress treatments depending upon the intensity and duration of water stress imposed (Fig. 1). In the

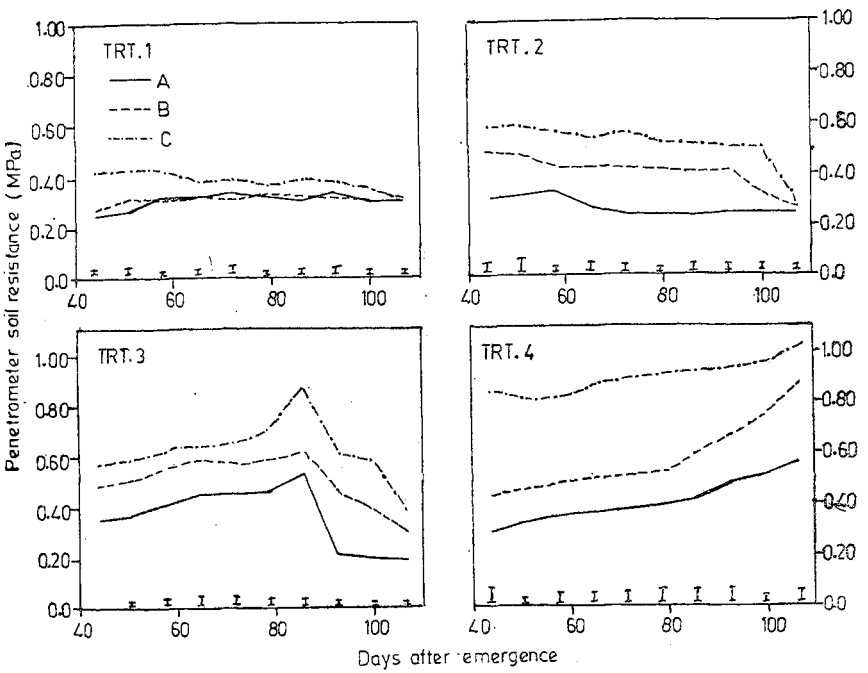

Fig. 1. Seasonal changes in penetrometer soil resistance in different treatments. Vertical bars indicate standard error.

treatment 1, where drought stress was released early in the season, PSR values were mostly below 0.40 MPa. Under continuous drought stress from emergence to maturity in treatment 4C, PSR was always above 0.80 MPa.

Since PSR was measured in the surface 7 cm soil depth, soil water content in the surface 10 cm measured at weekly intervals were used to examine the relationship between the PSR and soil water. As shown in figure 2, PSR increased exponentially with decrease in soil water below 0.80 m^3m^{-3} indicating that under such conditions pegs may experience considerable difficulty in penetrating the soil. Underwood *et al.* (1971) and Boote *et al.* (1976) observed that pegs frequently failed to effectively penetrate the air-dry soil thus preventing the fruit growth. Adequate pegging zone soil moisture was critical for peg development into pods and adequate soil moisture in the root zone was reported not to compensate for the requirement for pegging zone moisture for the first 30 days of peg development (Ono *et al.*, 1974).

High PSR may imply lower pod number for peanuts since fewer pegs penetrate the soil and produce pods. Pod number per plant measured at 90 DAE and pooled

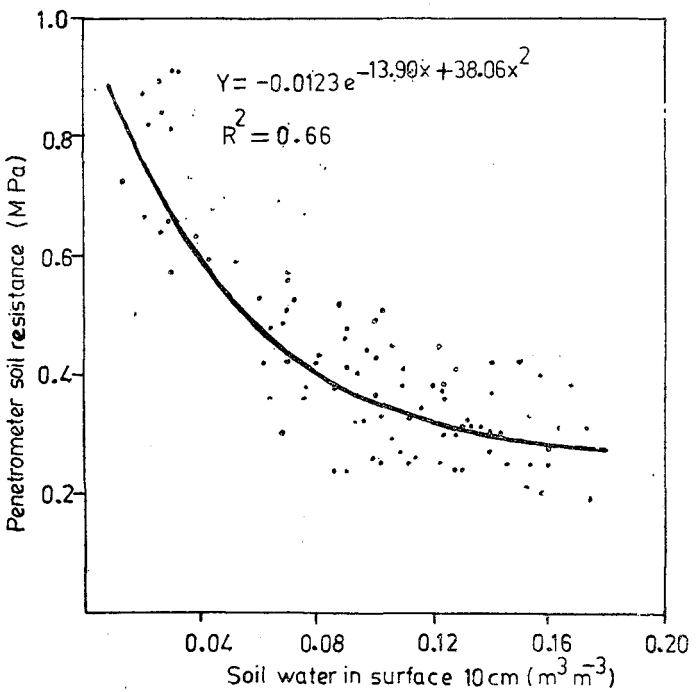

Fig. 2. Penetrometer soil resistance as related to soil water in the surface 10 cm. (Data pooled over all the treatments).

over the different stress treatments showed a linear decrease with increase in PSR (Fig. 3).

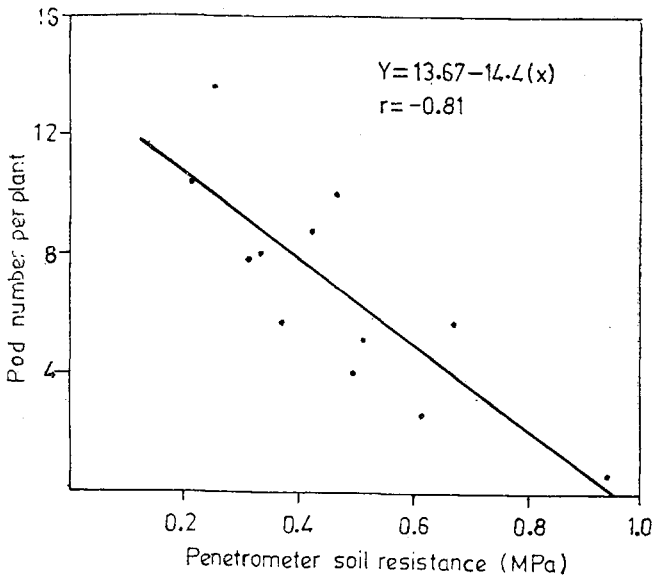

Fig. 3. Relationship between penetrometer soil resistance and pod number per plant measured at 90 DAE.

Final yield was not directly related to mean seasonal PSR since PSR, *per se*, does not reduce yield as all the commonly used strengthening devices such as the one used in this study, integrate their measurements over soil volumes substantially larger than the size of the peanut pegs (Taylor, 1981).

Despite the lack of direct cause-effect relationship of PSR with yield, the results obtained in the present study quantify under field conditions, the limiting soil water level at which PSR rapidly increases and results in lower pod number.

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